and cross-laps. Statistical analysis was performed using logistic regression, taking into account age, sex, BMI, and bilaterality.

Results: There was no significant difference between the three groups for:COMP, MMP-1, TIM P-i, HA collagen C-terminal propeptide and cross-laps. CRP (mean+SD) was significantly higher in group I (6.51 mg/l +8.6) than in group 11(2.79 mg/l + 2.6) (p=O.049). The significant difference disappeared when joint space thickness was used as confounding variable (CRP group III: 3.33mg/l+2.73 ; p=O.1)

Conclusion: These results suggest that serum markers are not of interest to predict rapidly destructive progression in hip OA. A low-grade inflammatory process might be involved in the pathogenesis of RDHOA

PB54

REPRODUCIBILITY OF *IN VIVO* CARTILAGE MAGNETIC RESONANCE IMAGING T_2 PROFILES

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Aim: The aim of this study is to evaluate reproducibility of cartilage magnetic resonance imaging (MRI)-T2 profiles in young asymptomatic volunteers.

Methods: Knees of 4 asymptomatic adults (age 22 to 39) were evaluated with a Bruker 3 T MR imaging-spectrometer using a 14 cm transmit-receive birdcage coil. Sagittal proton density and T2 maps of the femoral tibial joint were calculated from a 6 slice, 11 echo sequence with TR/TE = 1500/10-110 ms, 4 mm slice thickness, 3842 matrix and a 12.75 cm field of view. Axial T_2 maps of the patellofemoral joint were obtained from 5 slices with a 3 mm ST, 2562 matrix, and a 14.00 cm FOV. Automated computer subroutines were used to segment regions of interests (ROIs) of patellar, femoral and tibia! cartilage and generate cartilage MRI-T2 profiles. Cartilage MRI-T2 profiles represent the mean value of cartilage T, as a function of normalized distance from subchondral bone for the specific ROL.

Intra-session reproducibility was determined by calculating pooled coefficient of variation (Cvr) for 3 MRI-T2 profiles obtained during a single imaging session. Sessions were repeated three times on separate days, with comparison of the 1 of 3 data sets to determine inter-session reproducibility.

Results: Intra-session Cvt is less than *15%* and inter-session Cvt is less then 20% for the entire T2 profiles at all locations. Variation is less for patellar cartilage compared to femoral and tibia! cartilage. Variability is greatest at the bone/cartilage interface and articular surface.

Conclusion: Volume averaging of cartilage at tissue interfaces is a major source of variation in cartilage T_2 profiles. Better precision in patient positioning and control for potential diurnal effects may reduce this source of variability. The sensitivity of cartilage T_2 to changes in structure and composition of articular cartilage make it a potential non-invasive marker of early osteoarthritis. High reproducibility of T_2 measurements supports the use of cartilage T_2 profiles as a reliable marker of cartilage matrix integrity for longitudinal studies.

PB55

A PHANTOM FOR QUALITY CONTROL OF MRI KNEE CARTILAGE VOLUME MEASUREMENTS IN CLINICAL TRIALS

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In-vivo serial measurements of knee cartilage volume using MRI have been proposed as a means of following the progression of osteoarthritis and its response to treatment. However, small tissue dimensions and slow rate of change place severe demands on the measurement techniques. In the present report we describe design specifications and performance characteristics of a phantom designed to assess these issues.

Methods: The phantom was designed to mimic the geometry of femoral cartilage. It consisted of a long cylinder containing a hollow 57.2 mm sphere with a 50.8 mm diam. solid sphere attached to the inner wall. The space between the solid inner sphere and the hollow outer sphere was filled with with 0.25 mM Gd-DTPA solution, and the body of the phantom was filled with distilled water. Imaging was done using a 1.5 T GE Signa LX system and an extremity coil. The system was serviced monthly and the gradients adjusted to within 0.5%. The imaging was done at five timepoints spread evenly over 150 days. The mean total volume and CV of the different slices were calculated using intensity-based segmentation algorithms. Machine drift was calculated based on changes in the computed volume measurement over time.

Results: The mean computed volume over the five timepoints was 99.6% ± 0.6% of the true volume, with the range being 99.1% - 100.4%. The slope of the line was not being significantly different than zero. The CV of the total volume measured on the MR images was 3.03%, based on repeat measurements. The slice-by-slice RMS CV was 9.35%. In-plane linear measurements were accurate to one pixel, or 0.5 mm. The measured volume of the annular space (the model "cartilage") in the spherical phantom was 98.8 % ± 3.0 % of the true value.

Discussion: The variability in volume measurements is comparable with the cumulative error in the gradients (3x0.5%=1.5%), and therefore can be attributed to partial volume errors caused by variations in the gradients. The phantom highlights the sensitivity of the volume measurement to inclusion or exclusion of boundary pixels. Changing the thickness at either the inner or the outer boundaries by one pixel will change the integrated area of the annulus by 7%. The results also indicate that for a well controlled MR machine, cartilage volume is not significantly impacted by machine drift. These results provide a benchmark to assess MR drift characteristics for cartilage volume and other similar measurements.

PB56

A TECHNIQUE FOR MEASURING CHANGES IN CARTILAGE MORPHOLOGY AT SITES OF FOCAL T2 ABMORMALITIES IN MRI OF THE KNEE

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Aim: We aimed to develop and test a technique for measuring of serial changes in cartilage morphology at sites of T2 abnormalities visible on knee MRI.

Methods: Two patients who had recently undergone meniscal surgery, and two normal subjects, were examined using T2 weighted fast spin-echo (T2-FSE), and a fat suppressed spoiled

gradient echo (SPGR) sequences, on a 1.5T MRI scanner, at baseline and 12 month follow-up. An expert radiologist determined the position and extent of cartilage abnormalities visible on T2-FSE images at baseline and marked a cylindrical region of interest (ROT) centered on abnormalities. Image registration and segmentation techniques were used to determine cartilage thickness within the ROI at baseline and on the follow-up scan. The reproducibility of the technique was estimated using the normal subject, and changes in cartilage thickness due to lesion development in the patient were determined.

Results: The patients had a T2 abnormalities on their femoral condyles. The normal subjects exhibited no T2 abnormalities, so positions similar to those in the patients were marked by the radiologist. In the patients the T2 abnormalities persisted and developed into visible lesions on the follow-up SPGR scan. Measurement of total femoral cartilage thickness within the patients showed a loss of between 1% and 2% due to the lesions, with l/6th of the cartilage within slices containing the lesion being lost. In the cylindrical ROI around the site of T2 abnormality, the loss of cartilage volume was 66%. The reproducibility of the technique was estimated as 1.1%, since this was the average change in volume within the cylindrical ROI on the normal subjects.

Conclusions: Measurement of total femoral cartilage volume appears to be an insensitive technique for measuring changes in cartilage thickness and volume due to the development of lesions following meniscal surgery. By using image registration, it is possible to define cylindrical regions of interest around T2 abnormalities on baseline scans, and use image segmentation techniques to reliably measure changes in cartilage volume at the lesion sites. Although further patients and normal subject require examination, it appears that the technique has a high reliability (1.1%) for measuring changes in volume. It would also be useful to examine such changes in patients with idiopathic OA.

PB57

CARTILAGE VOLUME DETERMINATION FROM MAGNETIC RESONANCE IMAGES OF THE HUMAN WRIST

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Purpose: To evaluate the inter- and intra- operator reproducibility of LIVEWIRE segmentation in determining articular cartilage volumes from MRI.

Methods: We validated the volumetric rendering capabilities of LIVEWIRE segmentation by imaging two patellar-cartilage shaped phantoms of known volume (10.43 & 7.51 mm^3). Following validation, the right-hand wrist joints of two healthy volunteers (ages 20 and 22) were each imaged once. All imaging was performed on a 4T GE Signa scanner with a custom-built quadrature birdcage coil. Images of the validation phantoms and the wrist joints were obtained using a 3D spoiled gradient echo (SPGR) pulse sequence with an 8cm FOV, slice thickness of 1.5mm, TE/TR=20/60ms. All images were processed using the LIVEWIRE segmentation routine within the 3DVJEWNIX software. Inter- and intraoperator reproducibility was evaluated by having each of three operators (1 trained (Op1) 2 untrained) segment the data sets twice.

Results: The volumes of the two validation phantoms determined by water displacement differed from the volumes determined by LIVEWIRE segmentation by less than 1%. Results from *in vivo* data show that intraobserver measurements differed from each other by between 0.2% (for the trained) and 4% (for the 2 un-trained). The inter-observer differences (between average volume from two trials) ranged between 0.17% and 1.76%.

mm^3	OpIA	OpiB	Op2A	Op2B	Op3	Op3B
subject 1	978.3	962.1	941.1	983.9	961.4	997.5
subject 2	1058.7	1062.2	1055.1	1057.2	1044.9	1072.3

Conclusions: LIVEWIRE segmentation is an extremely accurate and reproducible method for determining volumes from MRI proton images. Our results, however, suggest that a degree of training is required to maximize segmentation reproducibility. Since cartilage volume changes are expected in OA, LIVEWIRE segmentation may be an effective method for long-term monitoring of cartilage degeneration.

PB58

MEASUREMENT OF THE TIBIAL SUBCHONDRAL BONE MINERAL DENSITY: A POTENTIAL TOOL FOR DIAGNOSIS AND MONITORING OF KNEE OSTEOARTHRITIS

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Background: It is now widely recognized that osteoarthritis (OA) is a global process which involves the participation of the cartilage, the synovial membrane and the subchondral bone. Moreover, it has previously been reported that bone sclerosis is associated with severity and long-term progression of OA. Nevertheless, precise methods for the quantification of sclerosis are not fully validated.

Objective: The aim of our study is to validate the measurement of the medial tibial subchondral bone mineral density (BMD) by dual X ray absorptiometry (DXA).

Methods: Bone mineral density was assessed with a commercially available DXA equipment (Hologic QDR 2000, Waltham, MA). We selected 7 regions of interest (ROI), of various sizes and orientations, around the area with the highest degree of sclerosis at the narrowest point of the medial knee joint. We then compared the analytic properties of the BMD assessment in these 7 ROI. Coefficient of variation (CV %) of the technique was assessed by repeating 5 measurements, over the same day, in OA and non-OA knee.

Results: Our results showed a precision from 2.1 % to 3.1 %, depending of the chosen ROI. When considering only the intact knee, the respective value of the CV varied from 2.3 % to 5.3 %, while for OA joint, the respective value were from 1.5 % to 3.0 %.

Conclusion: We were able to identify a ROI where assessment of subchondral bone density can be obtained with a precision of 2.6 and 1.5 %, in normal and OA knee, respectively. This precision is in the same range as reported for BMD measurement in other site (hip, spine, radius, total body). We conclude that tibial medial sclerosis could be precisely assessed by DXA and therefore could be investigated as a potential diagnosis and predictive tool in OA studies.